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D. M. BEACH, *Editor*

May 1940

The reports of research published in this magazine are necessarily qualified by the conditions of the tests from which the data are obtained. Whenever it is deemed possible to do so, generalizations are drawn from the results of the tests; and, unless this is done, the conclusions formulated must be considered as specifically pertinent only to described conditions.

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LOCAL IMPOSTS ON MOTOR VEHICLES IN MISSOURI

By JOHN H. LONG, State Manager, and BAILEY H. MAYES, Financial Manager, Missouri State-wide Highway Planning Survey

DETAILED data about the extent and incidence of State highway-user imposts have been collected and are being analyzed in 46 States in connection with the State-wide highway planning surveys. Information about similar local taxation is also essential for highway finance planning. Progressive changes in State and local tax policies and methods can be made only if adequate information is available to indicate the probable effect of any proposed changes on local governmental operation.

owners residing within the limits of the municipality levying the particular tax or fee. Complete data on this phase of local taxation in all States are not yet available.

Initial inquiry was made into the legal status of local motor-vehicle taxation in Missouri. Limits on the rates of municipal license fees were first provided in 1919. Since that time several changes in the law have been made and the State license fees, forming the basis upon which the local fees were charged, have been revised. Two conflicting provisions for limiting the

Over \$65,000,000 was collected in Missouri through State and local motor-vehicle imposts during the 3-year period 1934-36.

License fees and motor-fuel taxes imposed by Missouri municipalities represented \$10,658,000, or 16.1 percent, of the total motor-vehicle imposts. Of this, \$4,742,000 was collected in local license fees and \$5,916,000 in municipal motor-fuel taxes.

State imposts of \$55,402,000, or 83.9 percent of the total, were derived from \$24,687,000 of motor-vehicle registration and allied fees and \$30,715,000 of motor-fuel taxes.

Local license fees or motor-fuel taxes were imposed in 289, or 37.2 percent, of the 778 incorporated places in the State. All places with a population of 5,000 or more imposed one or both of these taxes, so that 91.7 percent of the people living in incorporated places in Missouri were subject to these imposts.

Local motor-fuel taxes were not as commonly used as local license fees. In 17 municipalities the motor-fuel tax was the only local motor-vehicle impost, while in 223 places the license fee was the sole local motor-vehicle impost, and in 49 places both types of impost were employed.

During the 3-year period studied the average Missouri motor-vehicle owner living in a municipality where local highway-user taxes were imposed paid \$3.28 in local license fees and \$5.33 in local motor-fuel imposts. Payments in Kansas City and St. Louis in the same period for city license fees were \$4.33 and \$4.30 per vehicle, respectively, while city motor-fuel taxes amounted to \$6.86 and \$5.57 per vehicle, respectively.

Receipts from local motor-vehicle imposts did not increase as rapidly during the 1934-36 period as did receipts from State motor-vehicle imposts. Relatively greater ease of evasion of local taxes as well as other difficulties encountered in their collection appear to limit their effectiveness as sources of local revenue.

Information concerning the extent and incidence of State highway-user taxes in Missouri has been made available by the State-wide highway planning survey initiated in Missouri in 1935. Similar information about local taxes imposed on motor-vehicle owners in Missouri was collected for the 3-year period, 1934-36.

Local taxes on motor-vehicle owners as reported in this study are of two types—local license fees and local motor-fuel taxes.

The local motor-fuel taxes are comparable with the State motor-fuel taxes utilized by all States to raise revenue for highway purposes. Missouri is one of only seven States in which local governmental units levy taxes on motor fuels. Some counties in Alabama and Mississippi collect such taxes while cities and towns in Alabama, Florida, Louisiana, Missouri, New Mexico, and Wyoming collect motor-fuel taxes at varying rates. The maximum rates of local motor-fuel tax charged in the several States are shown in table 1.

Local motor-vehicle license fees are used much more extensively than are local motor-fuel taxes. Missouri is one of several States in which these taxes are levied. They are called variously license fees, wheel taxes, city tag fees, etc., and are levied against the motor-vehicle

rates charged by cities and towns were contained in the Missouri statutes from 1929 until 1935. Partly because of the changes in the laws and the confusion resulting from the conflicting provisions, a number of different schedules of maximum local license fees have been in effect.

TABLE 1.—Maximum gasoline tax rates in States having local motor-fuel taxation in 1939

State	Gasoline tax per gallon		
	State	County ¹	City or town ²
Alabama	\$0.06	\$0.03	\$0.02
Florida	.07		.01
Louisiana	.07		.02
Mississippi	.06	.03	
Missouri	.02		.01
New Mexico	.05		.01
Wyoming	.04		.01

¹ Highest rate reported in any county, city, or town.

² New Orleans repealed its 2-cent tax Oct. 1, 1939.

The various steps by which these rates have developed and the evolution of the present schedule are discussed in detail in the Appendix to this report, page 61. At

the present time any city or town wishing to initiate such local taxation may establish license rates at not to exceed one-third of the present State rates. Cities that collected local license fees prior to 1933 are permitted to continue charging rates in excess of the later limits. The maximum legal rates are shown in table 2.

TABLE 2.—Comparative schedules of Missouri motor-vehicle license fees

PASSENGER CARS			
Basis of fee	State rate established 1933-34	Maximum legal rate for cities that adopted local license fees—	
		Prior to 1933 ¹	After 1933 ²
Less than 12 horsepower.....	\$5.00	\$2.50	\$1.66
12 and less than 24 horsepower.....	8.50	4.25	2.85
24 and less than 36 horsepower.....	11.00	5.50	3.66
36 and less than 48 horsepower.....	20.00	7.50	6.66
48 and less than 60 horsepower.....	25.00	8.50	8.33
60 and less than 72 horsepower.....	31.50	10.50	10.50
72 or more horsepower.....	37.50	12.50	12.50

COMMERCIAL VEHICLES			
Less than 2 tons.....	\$10.50	\$3.50	\$3.50
2 and less than 5 tons.....	18.00	6.00	6.00
5 and less than 6 tons.....	27.00	9.00	9.00
6 and less than 7 tons.....	30.00	10.00	10.00
7 and less than 8 tons.....	36.00	12.00	12.00
For every ton or major fraction thereof in excess of 8 tons.....	15.00	5.00	5.00

¹ Equal to one-third of 1925 State license fee rates except for passenger cars having 12 horsepower or less than 24 horsepower per vehicle. Because of confusion in the law some cities charged rates higher than these legal rates. See Appendix for discussion of statutory development.

² Based on one-third of the State rates established in 1933-34.

No provision has been found in the Missouri statutes either specifically permitting or prohibiting cities and towns from levying taxes on gasoline. The 1929 Revised Statutes permit the larger cities to license and regulate manufacturers, merchants, and dealers of all kinds, but this provision has not been construed as specifically applicable to gasoline taxes levied against the consumer. Although it has been applied to gasoline dealers, it does not appear to have been actually intended as a gasoline or sales tax but rather as a license for the privilege of doing business. However, the amount of tax to be paid in the several cities that have used it has been determined by levying a certain amount of tax per gallon of gasoline sold. The tax thus works out practically to be a gasoline sales tax, even though it apparently should be considered strictly an occupation tax, the 1-mill to 1-cent-per-gallon rate being merely the method of determining the amount of the occupation tax to be paid.

Similar provisions in the statutes apply to the intermediate and smaller cities and towns as well as the larger places. Under these provisions, various municipalities have passed ordinances placing a gallonage tax on gasoline which, instead of being paid by the dealer out of his gross income, has been treated as a direct tax on the purchaser.

The general concept, that the tax was basically an occupation tax, was supported by the State Supreme Court in 1924. Nevertheless, the fact that the tax is generally regarded as a direct tax against the motorist is evidenced by the sales charts posted on gasoline pumps in cities where such a tax is collected. A typical chart is shown in figure 1.

It is apparent, then, that though the local licensing of motor vehicles in Missouri is provided for by State



FIGURE 1.—TYPICAL SALES CHART POSTED ON GASOLINE PUMPS IN CITIES WHERE LOCAL GASOLINE TAXES ARE COLLECTED.

statutes, the status of the local motor-fuel taxes is somewhat poorly defined.

DATA OBTAINED FROM QUESTIONNAIRES AND HIGHWAY PLANNING SURVEY

Data for this study of local motor-vehicle imposts in Missouri were obtained from questionnaires returned by town and city officials throughout the State. Replies were received from practically all towns or cities that collected local highway-user taxes. Additional and supporting information was also obtained from the financial studies of the highway planning survey. The questions included on the forms sent out by the State Highway Department were:

1. Does your city collect a city gasoline tax?
2. At what rate per gallon?
3. What was the total amount collected for the fiscal years: 1934?; 1935?; 1936?
4. Is the revenue credited to general revenue account?
5. If not, to what special use is the revenue put?
6. Does your city collect a motor-vehicle registration fee?
7. At what rates for cars?; for trucks?
8. What was the total amount collected for the fiscal years: 1934?; 1935?; 1936?
9. Is the revenue credited to general revenue account?
10. If not, to what special use is the revenue put?

Analysis of the replies by city and town officials to the questionnaires indicated that there was a wide range in the motor-vehicle license fees charged in the various places. For passenger cars the fees ranged from 25 cents to \$12.50 per year, while for trucks the range was from \$1.50 to \$15. In some places, flat rates were charged; in others, the rates were based on the horsepower of the vehicles. In some places the local fees were assessed on the same basis as the State fees. One city reported a fee for trucks only. Some cities

TABLE 3.—Incorporated places in Missouri which assessed local motor-vehicle license and motor-fuel taxes, 1934-36

Population group	All incorporated places ¹		Places that reported assessment of local—							
			Motor-vehicle license fees				Motor-fuel taxes			
	Number	Population	Number	Percent	Population	Percent	Number	Percent	Population	Percent
Incorporated places having a population of—										
0-1,000	² 587	204,687	³ 122	20.8	70,444	34.4	18	3.1	9,662	4.7
1,001-2,500	⁴ 118	181,065	82	69.5	129,273	71.4	21	17.8	32,198	17.8
2,501-5,000	⁵ 36	126,123	31	86.1	108,723	86.2	8	22.2	29,628	23.5
5,001-10,000	21	151,136	21	100.0	151,136	100.0	8	38.1	63,496	42.0
10,001-25,000	10	165,060	10	100.0	165,060	100.0	6	60.0	100,285	60.8
25,001-100,000	4	197,725	4	100.0	197,725	100.0	3	75.0	164,271	83.1
Kansas City	1	399,746	1	100.0	399,746	100.0	1	100.0	399,746	100.0
St. Louis	1	821,960	1	100.0	821,960	100.0	1	100.0	821,960	100.0
Total	778	2,247,502	272	35.0	2,044,067	90.9	66	8.5	1,621,246	72.1

¹ U. S. Bureau of the Census, 1930.² Includes Des Peres (536) and Camdenton (850) incorporated since 1930.³ One place in this group assessed license fees on trucks only.⁴ Includes Olivette (1,180) and Afton (1,200) incorporated since 1930.⁵ Includes Flat River (2,631) incorporated since 1930.

reported that their ordinances provided for a license fee but that they had no collections because "the car owners did not want to pay it." In several places the wheel tax, or license fee, also included a 25-cent fee for collection. Table 3 shows the extent of use of local license fees in Missouri cities and towns.

Most towns and cities reported the same basic rates for both passenger cars and trucks. In 164 places the same rates were charged for all vehicles, while in 28 places the fees were graduated on the same basis for passenger cars and trucks. In some places these graduated fees were based on one-third, one-fifth, or 15 percent of the State rate; in others the rates charged were stated as varying from \$1.50 to \$2.50, or \$2 to \$5, or \$3 to \$6.50. One place reported that only trucks were charged a license fee and the rate was \$2 for all capacities of trucks.

The rates of motor-fuel taxes charged in Missouri localities did not vary as greatly as did the motor-vehicle license fees, nor did as many places levy this form of tax. Table 3 also shows the number and percentage of incorporated places that levied local motor-fuel taxes in 1934, 1935, and 1936.

Almost all of the 66 communities that levied local motor-fuel taxes used either the $\frac{1}{2}$ - or 1-cent tax. One town, a place having less than 1,000 population, had a 1-mill rate and reported collections for the 3-year period of \$453. Two towns reported a $\frac{1}{4}$ -cent rate; while of the remaining 63 places, 32 used the $\frac{1}{2}$ -cent rate and 31 used the 1-cent rate. Both St. Louis and Kansas City charged the 1-cent rate. The weighted average motor-fuel tax rates, by population groups, are given in table 4.

TABLE 4.—Average rates of motor-fuel tax¹ levied by Missouri municipalities, 1934-36

Population group	Average motor-fuel tax per gallon			
	1934	1935	1936	1934-36
Incorporated places having a population of—				
0-1,000	\$0.0058	\$0.0057	\$0.0053	\$0.0056
1,001-2,500	.0068	.0070	.0071	.0070
2,501-5,000	.0064	.0064	.0061	.0063
5,001-10,000	.0068	.0066	.0065	.0066
10,001-25,000	.0082	.0083	.0082	.0082
25,001-100,000	.0090	.0092	.0091	.0091
Kansas City	.0100	.0100	.0100	.0100
St. Louis	.0100	.0100	.0100	.0100
Total	.0093	.0095	.0095	.0094

¹ Determined by weighting collections in each municipality by rate of tax per gallon.

Thus, of the 778 incorporated places in Missouri, it was found that 223 cities and towns assessed only a license tax, 17 assessed only a motor-fuel tax and 49 places assessed both types of tax. In all, 289 municipalities in Missouri derived some revenue from local motor-vehicle imposts during the period 1934-36. Further detail of this information, by population groups, is shown in table 5.

COLLECTIONS INCREASED EACH YEAR DURING 1934-36 PERIOD

Collections from these two taxes levied by local units averaged approximately $3\frac{1}{2}$ million dollars per year for the period 1934-36 (table 6). Receipts from local motor-fuel taxes were higher than those from license fees in each of the three years. Receipts from both taxes increased each year. The individual reports showed only 3 places, with populations of 854, 3,507, and 4,485, that reported no license fee collections in 1936 but had reported collections for 1934 or 1935 or for both years.

Collections from local license fees in 1936 were less than in 1934 in 80 Missouri cities and towns. Of these 80 towns and cities, 28 were places having less than 1,000 population, 32 were places having 1,001 to 2,500 population, 11 had populations of 2,501 to 5,000, 6 had populations of 5,001 to 10,000 and 3 were in the 10,001 to 25,000 population group.

Two possible reasons for the decreased license fee collections in these 80 towns and cities as contrasted with increased registrations for the entire State may be suggested. A shift in motor-vehicle ownership to those areas and places where no fees were charged might have occurred, but complete data on actual motor-vehicle ownership by places during this period are not available to prove or disprove this. The decrease may have been due also to less efficient collection of the fees in some towns, because of increased opposition to and evasion of such charges by motor-vehicle owners.

Total collections from local motor-fuel taxes increased in each of the 3 years (except for the 1,001-2,500 population group). Only 18 places reported collections in 1936 that were lower than those in 1934, and 2 of these places had discontinued the tax since 1934. Four of the places that reported decreases had populations of 1,000 or less, 8 had populations between 1,001 and 2,500, and the other 4 had populations greater than 2,500. Three cities that reported no local motor-fuel taxes in 1934 had inaugurated them by 1936.

TABLE 5.—Incorporated places in Missouri that assessed local motor-vehicle imposts, 1934-36

Population group	All incorporated places ¹		Places that reported assessment of—															
	Number	Population	License fee only				Motor-fuel tax only				License fee and motor-fuel tax				Total			
			Number	Percent	Population	Percent	Number	Percent	Population	Percent	Number	Percent	Population	Percent	Number	Percent	Population	Percent
Incorporated places having a population of—																		
0-1,000.....	587	204,687	111	18.9	63,494	31.0	7	1.2	2,712	1.3	11	1.9	6,950	3.4	129	22.0	73,156	35.7
1,001-2,500.....	118	181,065	71	50.2	112,483	62.1	10	8.5	15,408	8.5	11	9.3	16,791	9.3	92	78.0	144,681	79.9
2,501-5,000.....	36	126,123	23	63.9	79,095	62.7					8	22.2	29,628	23.5	31	86.1	108,723	86.2
5,001-10,000.....	21	151,136	13	61.9	87,640	58.0					8	38.1	63,496	42.0	21	100.0	151,136	100.0
10,001-25,000.....	10	165,060	4	40.0	64,775	39.2					6	60.0	100,285	60.8	10	100.0	165,060	100.0
25,001-100,000.....	4	197,725	1	25.0	33,454	16.9					3	75.0	164,271	83.1	4	100.0	197,725	100.0
Kansas City (399,746).....	1	399,746									1	100.0	399,746	100.0	1	100.0	399,746	100.0
St. Louis (821,960).....	1	821,960									1	100.0	821,960	100.0	1	100.0	821,960	100.0
Total.....	778	2,247,502	223	28.7	440,941	19.6	17	2.2	18,120	0.8	49	6.3	1,603,126	71.3	289	37.2	2,062,187	91.7

¹ U. S. Bureau of the Census, 1930; see table 3 for revisions.² One place reported tax rate but no collections.³ In one place no license fee collections were reported, in another no gasoline tax collections, and in a third no collections from either tax were reported.⁴ Gasoline tax discontinued in one place after 1934.

TABLE 6.—Annual collections of local motor-vehicle imposts in Missouri by population groups, 1934-36

Population group	Annual collections in Missouri from—											
	Local license fees in—				Local motor-fuel taxes in—				Total local motor-vehicle imposts in—			
	1934	1935	1936	Total 1934-36	1934	1935	1936	Total 1934-36	1934	1935	1936	Total 1934-36
Incorporated places having a population of—												
0-1,000.....	\$14,863	\$15,922	\$18,167	\$48,952	\$5,979	\$6,063	\$11,145	\$23,187	\$20,842	\$21,985	\$29,312	\$72,139
1,001-2,500.....	46,867	48,375	49,318	144,560	33,910	30,229	32,235	96,374	80,777	78,604	81,553	240,934
2,501-5,000.....	50,283	52,677	51,757	154,717	36,915	36,969	39,670	113,554	87,198	89,646	91,427	268,271
5,001-10,000.....	95,762	92,773	101,967	290,502	63,917	65,030	68,076	197,023	159,679	157,803	170,043	487,525
10,001-25,000.....	111,368	111,215	117,083	339,666	107,413	108,883	115,037	331,333	218,781	220,098	232,120	670,999
25,001-100,000.....	135,324	122,611	149,337	407,272	144,714	168,295	172,686	485,695	280,038	290,906	322,023	892,967
Kansas City (399,746).....	352,271	365,503	379,825	1,097,599	552,959	582,401	605,849	1,741,209	905,230	947,904	985,674	2,838,808
St. Louis (821,960).....	717,117	738,217	803,981	2,259,315	626,749	1,123,162	1,177,587	2,927,498	1,343,866	1,861,379	1,981,568	5,186,813
Total.....	1,523,855	1,547,293	1,671,435	4,742,583	1,572,556	2,121,032	2,222,285	5,915,873	3,090,411	3,668,325	3,893,720	10,658,456

TABLE 7.—Comparison of population, registration, and State and local motor-vehicle imposts in Missouri, 1934-36

Population group	Percentage of—							
	Total population in incorporated places ¹	Total motor-vehicle registration in incorporated places ²	Local motor-vehicle imposts collected, 1934-36			State motor-vehicle imposts paid by vehicle owners of incorporated places, 1935 ³		
			License fees	Motor-fuel taxes	Total local imposts	License fees	Motor-fuel taxes	Total State imposts ⁴
Incorporated places having a population of—								
0-1,000.....	9.1	11.1	1.0	0.4	0.7	9.7	8.8	9.6
1,001-2,500.....	8.0	9.8	3.1	1.6	2.2	8.6	8.0	8.4
2,501-5,000.....	5.6	7.0	3.3	1.9	2.5	6.5	6.0	6.5
5,001-10,000.....	6.7	8.0	6.1	3.3	4.6	7.7	7.6	7.7
10,001-25,000.....	7.4	8.2	7.2	5.6	6.3	8.1	7.7	7.8
25,001-100,000.....	8.8	8.3	8.6	8.2	8.4	8.2	9.6	9.1
Kansas City (399,746).....	17.8	15.5	23.1	29.5	26.6	16.3	17.4	16.6
St. Louis (821,960).....	36.6	32.1	47.6	49.5	48.7	34.9	34.9	34.3
Total.....	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

¹ 1930 U. S. Census. Includes all incorporated places whether they collected local motor-vehicle taxes or not.² Based on highway planning survey analysis for 1935; includes all incorporated places.³ Based on highway planning survey analysis.⁴ Includes miscellaneous fees in addition to license fees and motor-fuel taxes.

The percentage relations of the amounts shown in table 6 and comparison with the motor-vehicle registrations and the populations of the various groups in the State are shown in table 7. These comparisons emphasize the great influence of the population concentrations of Kansas City and St. Louis.

During the 3-year period, receipts from similar highway-user taxes levied and collected by the State amounted to \$55,402,000, compared with the total local collections of \$10,658,456. The annual receipts from State highway user-taxes are shown in table 8. The

relative magnitude of local and State collections for each of the 3 years is also shown in figure 2.

LOCAL COLLECTIONS ABOUT TWO-FIFTHS OF STATE COLLECTIONS IN SAME LOCALITIES

Another desirable comparison is that between the amounts of State taxes and local taxes paid by motor-vehicle owners in only those places that assessed local highway-user taxes. In the highway planning survey a study of motor-vehicle allocation determined the approximate average amounts of State (highway-user)

TABLE 8.—Collections from State motor-vehicle and motor-fuel taxes in Missouri, 1934-36¹

Year	Collections from State—		
	License fees ²	Fuel taxes ³	Total
1934	\$7,346,000	\$9,682,000	\$17,028,000
1935	8,353,000	9,845,000	18,198,000
1936	8,988,000	11,188,000	20,176,000
Total	24,687,000	30,715,000	55,402,000

¹ State Motor-Vehicle Receipts, 1934, 1935, 1936; Disposition of State Motor-Fuel Tax Receipts, 1934; State Motor-Fuel Tax Receipts, 1935, 1936—U. S. Public Roads Administration.

² Includes other receipts in connection with the registration of vehicles, such as receipts for chauffeur's permits and certificates of title.

³ Includes other receipts in connection with the administration of the motor-fuel tax.

taxes paid by motor-vehicle owners in various population groups. This study also provided data showing the approximate numbers of vehicles in the several population groups and consequently the average number of persons per vehicle. Using these basic determinations it is possible to compute the approximate amount of State highway-user taxes paid by motor-vehicle owners resident in the localities that also levied local motor-vehicle and motor-fuel taxes. A summary of these computations is given in table 9.

TABLE 9.—Approximate collections of State motor-vehicle fees and motor-fuel taxes in Missouri municipalities that levied local highway-user taxes, 1934-36

Year	Approximate collections from State—		
	License fees	Fuel taxes	Total
1934	\$4,279,513	\$4,336,920	\$8,616,433
1935	4,756,408	4,448,914	9,205,322
1936	5,156,223	4,692,758	9,848,981
Total	14,192,144	13,478,592	27,670,736

Comparison of tables 6 and 9 indicates that during the years 1934-36, Missouri localities that levied motor-vehicle license fees and motor-fuel taxes collected approximately 33 percent as much in local license fees and approximately 44 percent as much in local fuel taxes as the State collected in similar taxes in the same localities. Comparison of tables 8 and 9 indicates that in places that levied local taxes there was collected 57 percent of the State motor-vehicle license fees and 44 percent of the State motor-fuel taxes collected from 1934-36.

Two further interesting comparisons can be made using 1930 census data for the populations of the various places that levied local motor-vehicle and motor-fuel taxes and the determinations of the highway planning survey for the approximate numbers of vehicles in the various population classifications. These two comparisons concern the collections per person and per vehicle in places of various sizes. By disregarding fluctuations over the 3-year period and by basing average per-capita and per-vehicle collection computations on the total collections in each of the population groups, on the total population involved and on the total number of vehicles involved, the comparisons shown in figures 3 to 6, inclusive, have been made.

It will be seen in figures 3 and 5 that average collections of local motor-vehicle license fees, on both a per-capita and a per-vehicle basis, vary consistently with the size of the population group involved. The

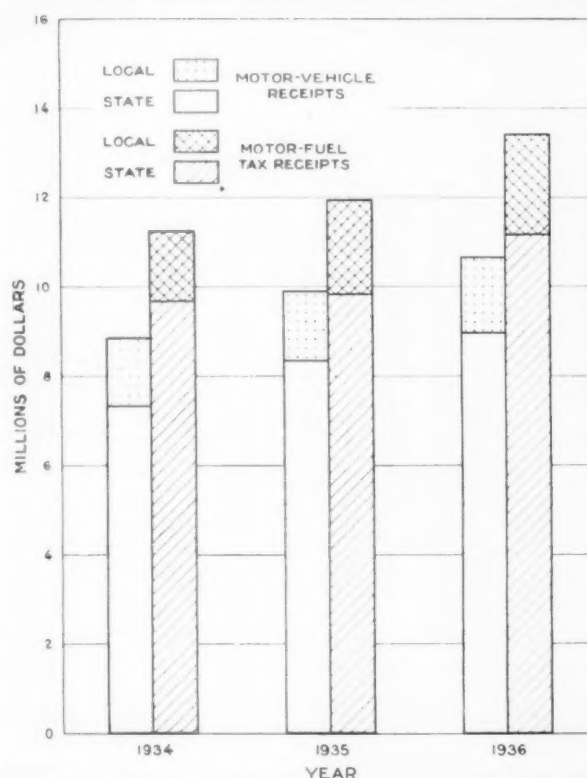


FIGURE 2.—RECEIPTS FROM STATE AND LOCAL HIGHWAY-USER TAXES IN MISSOURI, 1934-36.

regularity of this variation is most pronounced for the per-vehicle comparison. The averages for all places are larger in both cases than the averages for any group of places except Kansas City and St. Louis.

Figures 4 and 6 indicate no significant trends concerning the relation of local motor-fuel tax collections to the size of the places involved. Figure 6 is, however, significant in that it shows per-vehicle collections of motor-fuel taxes in Kansas City and St. Louis to have been higher than those for any other population group in the State. Two possible explanations for this condition, aside from the slight differences in tax rates given in table 4, are suggested. While motor-vehicle fees are strictly a measure of local contributions, the motor-fuel tax is not so accurate a measure. Motor-fuel taxes are collected from all persons purchasing motor fuel in the respective places regardless of whether or not the motor fuel is used in vehicles owned in those communities.

EVASION OF LOCAL GAS TAXES INDICATED

Kansas City and St. Louis, as urban centers of the State, attract large numbers of vehicle owners from elsewhere in the State and from other States and collect from them a certain amount of motor-fuel taxes in the normal course of such travel. Highway planning survey data indicate that the average urban-owned vehicle is driven a greater mileage each year than is the average car owned by residents of the smaller cities and unincorporated areas. Thus, using more motor fuel to accomplish such travel, the vehicle owners of those cities would contribute proportionately greater local fuel-tax revenues than would the vehicle owners of other cities, if gasoline were purchased within the city limits.

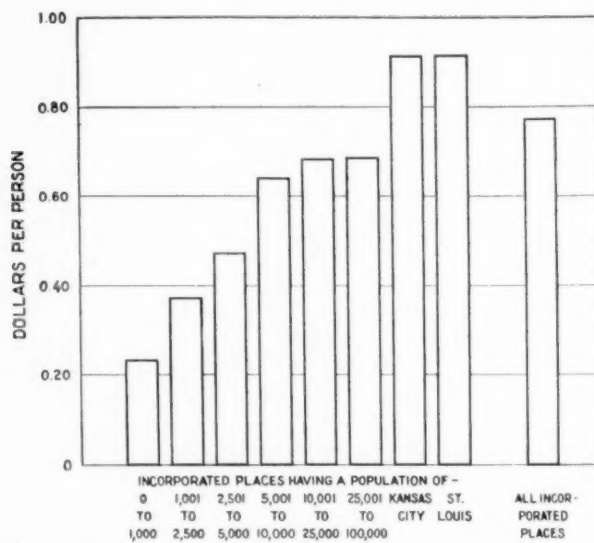


FIGURE 3.—AVERAGE COLLECTIONS PER PERSON OF LOCAL MOTOR-VEHICLE LICENSE FEES IN MISSOURI, 1934-36.

Comparisons between State and local motor-fuel tax collectors, especially in Kansas City and St. Louis, are of interest. Highway planning survey analyses indicate that in 1935 Kansas City motor-vehicle owners contributed \$1,247,232 and St. Louis motor-vehicle owners contributed \$2,502,517 in State gasoline taxes, on a 2-cent tax rate. If the State rate had been only 1 cent per gallon and gasoline consumption had remained the same, contributions from motor-vehicle owners in these two cities to the State motor-fuel tax revenues would have been \$623,616 and \$1,251,258, respectively.

These amounts may be compared with the actual collections by these two cities from the local 1-cent-per-gallon taxes. In 1935 local gasoline tax collections were \$582,401 and \$1,123,162, respectively. These amounts were 6.6 and 10.2 percent less, respectively, than comparable contributions to State gasoline taxes.

These differences may be partly accounted for by the fact that Kansas City and St. Louis vehicle owners buy some of their gasoline on trips away from their respective cities and thus avoid paying local taxes. At the same time residents of other places traveling to these two cities very probably purchase some gasoline within the city limits and thus offset the losses occasioned by residents buying some of their gasoline elsewhere.

To these two considerations must be added a third—that some gasoline used in these two cities escapes local taxation because it is purchased at filling stations located outside the city limits. Advertisement is often given to the fact that a station is outside the city limits and that the purchaser of gasoline can avoid the city tax on his purchases. Figure 7 shows two views of a filling station located outside a Missouri city in which local motor-fuel taxes are collected. Numerous other stations near the city limits similarly advertise the fact that no city tax is collected. A considerable portion of the difference between city and State collections cited above can probably be credited to this factor.

Questions 4, 5, 9, and 10 of the questionnaire sent to the cities and towns in Missouri were designed to determine the uses made of the local highway-user revenues. Not all of the cities and towns replied adequately to these particular questions but the answers from 260 places were of such a nature that a partial analysis

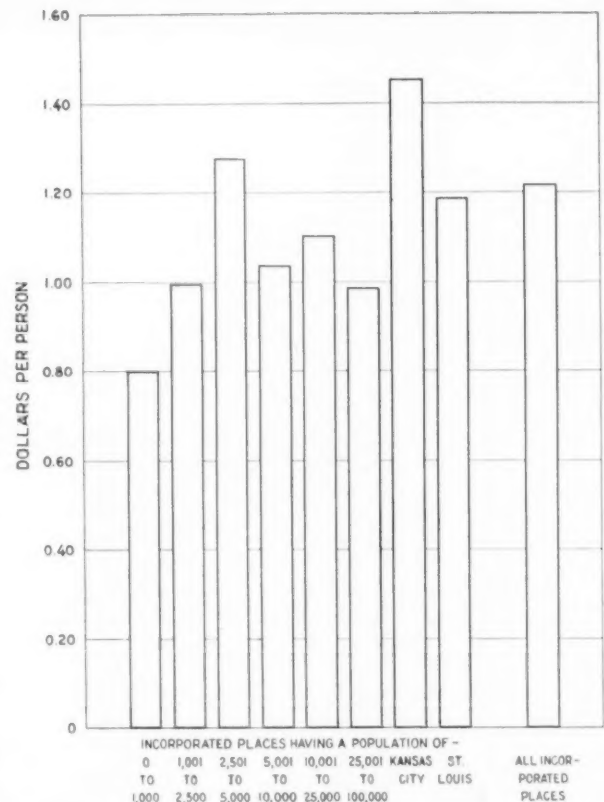


FIGURE 4.—AVERAGE COLLECTIONS PER PERSON OF LOCAL MOTOR-FUEL TAXES IN MISSOURI, 1934-36.

could be made. In addition, more detailed analyses of the Kansas City and St. Louis data for the 3 years were made. The percentage distributions of the funds for each of the 3 years studied in the 260 places reporting, exclusive of Kansas City and St. Louis, are shown in table 10.

TABLE 10.—Distribution of local motor-vehicle and motor-fuel taxes in 260 Missouri cities and towns, 1934-36

Year	Percentage of local highway-user taxes—		
	Paid to general revenue fund	Paid to street maintenance fund	Total
1934	52.3	47.7	100
1935	54.6	45.4	100
1936	53.9	46.1	100
Average	53.6	46.4	100

It appears reasonable to expect that in many places appropriations from the general revenue fund were used for street and alley improvements, so that the percentage of the total collections actually used for street purposes was undoubtedly larger than the 46.4 percent shown in table 10. Highway planning survey data indicate that in some places money collected from motor-vehicle owners in the form of local motor-vehicle and motor-fuel imposts was not spent entirely for street purposes, but in other places much more was used on the streets than was collected locally from motorists.

In one particular instance a city reported a collection from local highway-user taxes of \$15,000 in 1934 for its motor-vehicle license fund. Disbursements included

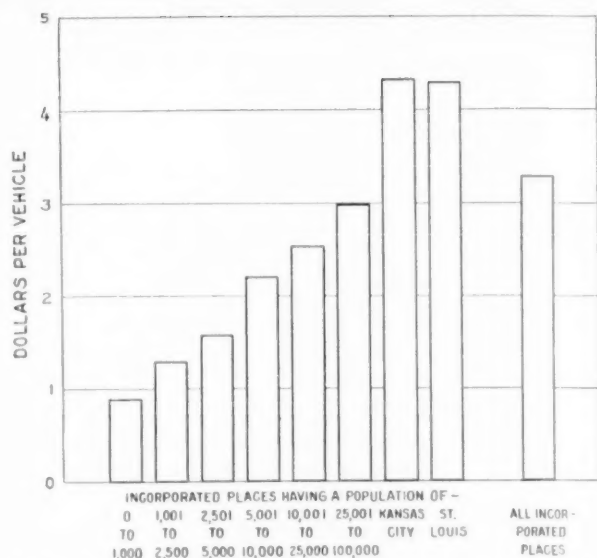


FIGURE 5.—AVERAGE COLLECTIONS PER VEHICLE OF LOCAL MOTOR-VEHICLE LICENSE FEES IN MISSOURI, 1934-36.

a transfer to the general fund of \$700 in addition to street expenditures of \$6,900. But there were payments amounting to \$27,000 for streets and bridges from the city's general fund. A similar condition existed in that city in 1935 when there were payments of \$23,000 for streets from the general fund in addition to net expenditures from the motor-vehicle license fund of \$12,300, as compared to net receipts from local highway-user taxes of \$12,000.

Both Kansas City and St. Louis used all of their revenues from locally imposed motor-vehicle taxes for street purposes, though for each of the 3 years the distributions to funds were actually as shown in table 11. The Kansas City ordinances provide that all gasoline tax money collected locally shall be used and expended for the repair, upkeep, and maintenance of the public streets and highways of that city. It is also provided in the city charter that:

Subject to the right of the city council to appropriate not to exceed 3 percent thereof to the fireman's pension fund, all sums derived from license taxes collected by the city * * * shall be appropriated and used exclusively for the maintaining, adorning, constructing, and repairing and otherwise improving the parks, parkways, boulevards or other highways.

TABLE 11.—Distribution of receipts from Kansas City and St. Louis local highway-user imposts, 1934-36

Year	Distribution of receipts in—			
	Kansas City to—		St. Louis to—	
	General revenue fund	Park districts ¹	Municipal fund	Interest and sinking fund
1934	\$555,981	\$349,249	\$1,290,639	\$44,227
1935	585,807	362,097	1,304,654	556,725
1936	610,126	375,548	1,396,182	585,386
Total	1,751,914	1,086,894	4,000,475	1,186,338

¹ Street and boulevard improvements.

SMALL PLACES RECEIVE PROPORTIONALLY GREATER BENEFITS FROM STATE HIGHWAY EXPENDITURES

Two further analyses and comparisons were made on the basis of available data. The first concerned the amount that would have been raised in any year if all

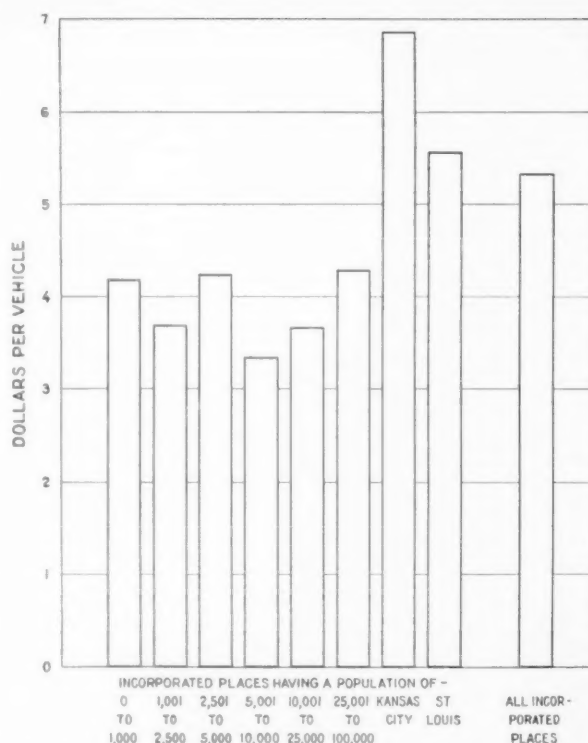


FIGURE 6.—AVERAGE COLLECTIONS PER VEHICLE OF LOCAL MOTOR-FUEL TAXES IN MISSOURI, 1934-36.



FIGURE 7.—TWO VIEWS OF A FILLING STATION LOCATED OUTSIDE A MISSOURI CITY. TOP, VIEW AS ONE APPROACHES THE CITY; BOTTOM, VIEW AS ONE LEAVES THE CITY.

incorporated places in Missouri had levied and collected local license and motor-fuel taxes equal to the average collections in those places of the same population classification that levied such taxes.

This comparison can be made on the basis of either the average receipts per person or the average receipts

per vehicle in the towns and cities where the taxes were collected. The comparison was made for 1936 and is shown in table 12. The computations were based on the 1930 population figures of the places affected and results of the 1935 motor-vehicle allocation study of the planning survey which determined the approximate number of vehicles in the various population groups. The average license fee collected in 1936 by 122 places having populations of 1,000 or less was \$0.258 per person, and the average motor-fuel tax collected by 18 places in the same population group was \$1.153 per person. The total population of all the 587 places in the population group was 204,687 which, multiplied by each of these per-person figures, gives \$52,809 and \$236,004, respectively. These, added together, give the \$288,813 shown in the third column of table 12.

This analysis indicates that the adoption of such a policy would have produced, when the population and registration basis results are averaged, an increased total annual collection of only \$795,587. More than \$600,000 of this increase would have been produced in the places having less than 5,000 population.

TABLE 12.—Estimated amounts that all Missouri cities and towns would have collected in 1936 in local highway-user imposts if rates were based on average receipts of those places that levied such taxes

Population group	Total local motor-vehicle imposts, 1936	Estimated collections for all places based on—		
		Population	Motor-vehicle registration	Average
Incorporated places having a population of—				
0-1,000	\$29,312	\$288,813	\$335,769	\$312,291
1,001-2,500	81,553	250,413	276,161	263,287
2,501-5,000	91,427	228,914	234,576	231,745
5,001-10,000	170,043	264,035	257,799	260,917
10,001-25,000	232,120	306,352	286,651	296,502
25,001-100,000	322,023	357,091	357,556	357,323
Kansas City (399,746)	985,674	985,674	985,674	985,674
St. Louis (821,960)	1,981,568	1,981,568	1,981,568	1,981,568
Total	3,893,720	4,662,860	4,715,754	4,680,307

It was previously pointed out that expenditures for city streets in many cities and especially in the larger cities exceed their receipts from local motor-vehicle imposts. In this same connection, it may be noted that statutory provision¹ for State highway construction in the smaller places has been made as follows:

Any State highway which passes through a municipality having a population of less than 2,500 according to the last United States census preceding such construction, shall be constructed through such municipality, and any highway which passes through a municipality having more than 2,500 population, according to such census, shall be constructed through the portions of the municipality where the houses abutting such roadway are not less than 200 feet apart on the average; *Provided, however*, That in either case the State shall not pay for road surfacing wider or of a higher type of construction than the road as constructed up to the boundary of such municipality.

It is thus apparent that the smaller places can receive proportionally greater benefits from the continued expenditure of State highway funds than can the larger towns and cities. Table 13 shows the expenditures made in 1934 by Missouri towns and cities on their own streets. Additional data on the expenditure of other funds in the various cities, based on highway planning survey results, show clearly that in the larger cities the State expenditures are a much smaller per-

centage of the total street expenditures than they are in the smaller places.

Direct comparisons of the amount of local highway-user taxes collected to the local street expenditures cannot be made because so many of the smaller cities did not collect local motor-vehicle taxes, and expenditure data for those that did cannot be readily separated from the data for those places that did not collect these local taxes. Though 22 percent of the places having 1,000 population or less collected local highway-user taxes, the amount they raised in 1934 was only 10.6 percent of the street expenditures of all places in that group. In the 2,501 to 5,000 population group, 86.1 percent of the places levied local highway-user taxes and collected a total amount equal to only 37 percent of the street expenditures of the entire group. In Kansas City receipts from local highway-user taxes in 1934 were 68.7 percent of the city's expenditures for streets, while in St. Louis the collections equaled only 32.3 percent of the total street expenditures by the city.

TABLE 13.—Expenditures for town and city streets in Missouri by population groups in 1934¹

Population group	Expenditures for local streets by—	
	Cities and towns	State highway department
Incorporated places having a population of—		
0-1,000	\$197,300	\$324,400
1,001-2,500	298,000	168,100
2,501-5,000	235,900	640,500
5,001-10,000	330,400	321,300
10,001-25,000	372,400	235,000
25,001-100,000	390,100	324,200
Kansas City (399,746)	1,316,900	576,600
St. Louis (821,960)	4,164,600	119,100
Total	7,245,600	2,709,200

¹ Does not include debt retirement.

In addition to the amounts shown in table 13, large amounts were spent in 1934 by Missouri towns and cities for the retirement of debt originally incurred for street purposes. Most of the \$5,667,600 of debt retirement so effected was accounted for by St. Louis where the amount retired was \$5,422,000. In all places having populations of 10,000 or less, the total street debt retired in 1934 amounted to only \$61,100.

SUMMARY

The data collected and analyzed in this study have importance in the general problem of street and highway planning in Missouri insofar as they indicate the degree of reliance of municipalities on these revenues and the relation of those imposts to State fees and taxes imposed on similar bases and for similar purposes. Any proposed statutory revision that would affect these taxes must be carefully analyzed to determine what effects on street and highway funds and on street and highway work would result.

This study has indicated that receipts from local imposts are not, for population groups as a whole, sufficient to meet the expenditures by cities and towns on their own streets. If present average impost rates were extended to all cities and towns in the State, the amounts so raised would fail to equal the amounts now spent for streets by the towns and cities of the various population groups, with the exception of the places having populations of 1,000 or less.

(Continued on page 61)

¹ Laws of Missouri relating to roads, highways, and bridges (Revised Statutes 1929); sec. 8133.

SOME EXPERIENCES WITH EXPANSION JOINTS IN CONCRETE PAVEMENTS

RUBBER AND RUBBER COMPOUNDS USED AS A FILLER OR SEAL

BY THE DIVISION OF CONSTRUCTION, PUBLIC ROADS ADMINISTRATION

Reported by ANDREW P. ANDERSON, Highway Engineer

CONSIDERABLE attention has been directed during recent years toward the development of more satisfactory materials for filling and sealing expansion joints in concrete pavements. One of these newer developments involves the use of rubber in various forms or in combination with various other materials. From time to time and at various places these new rubber compositions or combinations have been given more or less extensive trials on actual construction jobs. A good many of these materials have now been in service long enough to indicate something of their probable life and behavior under traffic. The results obtained from these tests, however, have apparently never been fully accumulated for comparative study. A fairly extensive inquiry has therefore been made as to the extent of use of these materials on Federal-aid work and the results indicated to date.

The returns include observations on more than a hundred projects distributed throughout 28 States where one or more of these joint fillers have been in service for a period of at least a year. The cases in which the results have been disappointing are far more numerous than those which have been satisfactory, as is frequently true during the period of development of new materials.

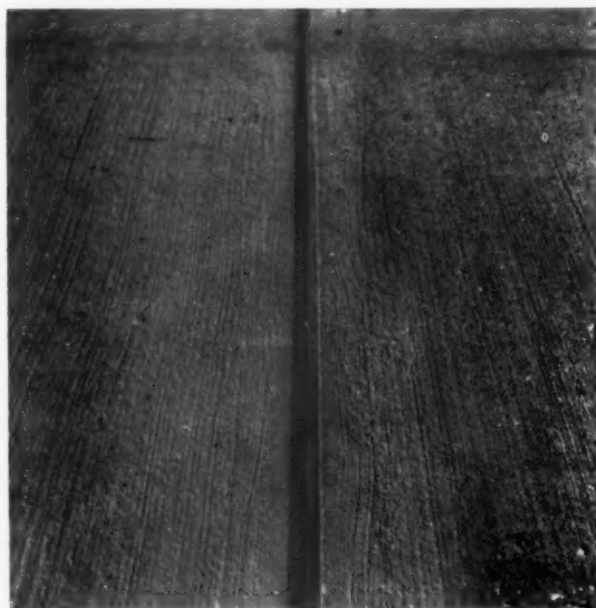
A fully satisfactory material for filling or sealing expansion joints in concrete pavements must be very elastic and fully able to accommodate itself to the movement of the slab without appreciable extrusion, and must always maintain such close contact with the ends of the concrete slabs as to prevent the entrance of either water or other foreign materials. It must be able to maintain these qualities for a considerable period of time without appreciable impairment, be easy to install, and be of relatively low cost.

No material has as yet been introduced which fully satisfies all these requirements. The standard bituminous filler is easy to pour or install, is of low first cost, but it is lacking in the required elasticity. As the slabs expand the filler extrudes, forming a ridge or bump for every passing vehicle. When the slabs contract the filler usually fails to take up the additional joint space, enabling water and foreign materials to gain entrance.

Rubber is a very elastic material but its cost is relatively high and it tends to deteriorate under the severe service conditions imposed by the combination of weather and traffic. Sponge rubber has been used for about 10 years as a joint filler. Recent inspections on 16 jobs indicate that where fully protected by a tight seal the behavior of this material has in general been satisfactory for a considerable period. But where no seal, or an ineffective seal, has been provided the sponge-rubber filler after about 3 years' service generally shows appreciable deterioration and loss of elasticity.

In Florida about 125 premolded, sponge-rubber joint fillers were installed on one job in the fall of 1936 and

early part of 1937. When inspected on November 16, 1939 it was found that the poured bituminous seal was gone from most of the joints. In these the unprotected rubber material had oxidized, become brittle, and begun to split and pull away from the concrete. This weathering action was found to have reached an average depth of about 2 inches. On the other hand, where the rubber had been continuously protected by the bituminous seal it remained alive to the top and made proper contact with the concrete.



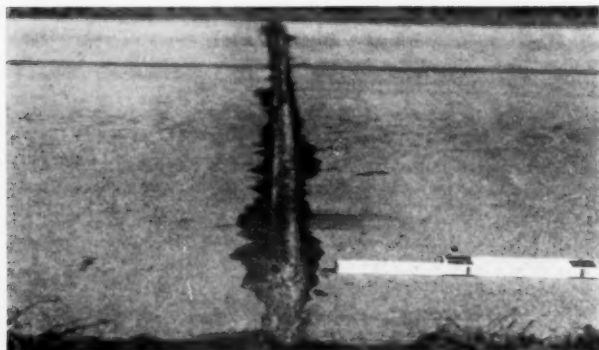
AN EXPANSION JOINT THAT APPROXIMATES DESIGN REQUIREMENTS.

SPONGE-RUBBER FILLERS OFTEN FOUND TO HARDEN AND SHRINK

In Indiana 1-inch premolded, sponge-rubber fillers were used in the expansion joints on a Federal-aid job in 1931. The joints were sealed but it was soon found that the cut-back asphalt then used as a seal and crack filler seemed to act on the sponge rubber in the joint and make it quite soft and more spongy. Therefore, on work in 1934, 1935, and 1936 the joints in which rubber was used as a filler were not sealed. A careful examination in November 1939 on seven of these jobs showed: First, that this type of premolded, sponge-rubber filler had taken on a permanent set in about 3 years of actual use; and second, that where the rubber was not protected by a good seal but was exposed to the weather, it soon became hard, lifeless, and shrank so that it no longer completely filled the joint space.

Careful measurements on the seven projects showed that the thickness of the existing rubber fillers at their narrowest places varied from one-half to seven-eighths

inch as compared with the original 1-inch width. Furthermore, while some set was found in the rubber filler on the early construction in 1931 and years immediately following in which the expansion joints were sealed, the permanent set was much less where the seal had been maintained than for the later construction where no seal was used or on the old construction where the seal of the joints had been broken.



APPEARANCE OF BITUMINOUS-FILLED JOINT AFTER THE FILLER HAS EXTRUDED DUE TO PAVEMENT EXPANSION.

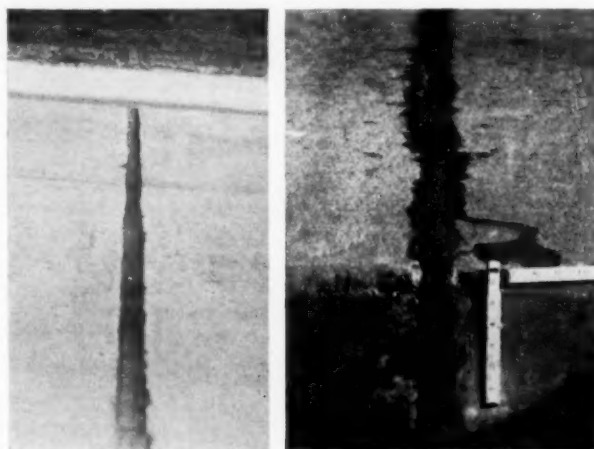
During more than 10 years of experience with sponge rubber joints in California highways it has been found that this material soon loses its resiliency and is in time compressed to a fraction of its original thickness, leaving the joint open when the slab contracts. Quite often the compressed filler is shredded and drawn out of the joint under the action of traffic.

In Minnesota five premolded, sponge-rubber expansion joint fillers were used in a pavement built in 1930. All five joints were sealed with hot-poured bituminous material. On November 9, 1939, it was found that where the seal had been poor or ineffective, the upper part of the sponge rubber was badly deteriorated, cracked, and lifeless. The lower part, however, was in good physical condition generally, and showed no loss of resiliency. Where the bituminous seal had given protection the oxidation, with resulting hardening, cracking and loss of material, was much reduced.

In Nevada sponge rubber was used as a filler for all the expansion joints on a 1.22-mile job in 1933. This material gave very good service in 1934, 1935, and 1936. During exceptionally hot weather in 1937, however, the filler extruded so badly that about half of the total amount in the joints was worn away by traffic and completely lost. When the joints were refilled and sealed that fall, it was noticed that the sponge rubber had largely lost its resiliency and had become somewhat brittle.

In order to overcome the objection of high cost of straight rubber products, various compounds have been developed in which cheaper materials are added to give bulk and so decrease the total cost. The more common of the ingredients added to the rubber latex are ground cork, ground or treated mica, mineral powders, tar, asphalt, etc. In these compounds rubber or rubber latex is the material relied on to supply the properties of elasticity and to give firm adhesion to the ends of the concrete slabs. Sometimes these compounds are used as a complete filler of either the poured or premoulded type but more frequently they are used as a seal to cheaper materials which occupy the greater part of the joint space, or to seal joints of the premolded or metal type.

Included in such compounds are a large number of proprietary products, the exact compositions of which are frequently not revealed. Some of these products are poured cold; others must be heated. Some are sold all prepared and ready for application, while others must be combined on the job before they are ready for use. For some the application is completed in one operation, while others require two or more operations, such as first priming the edges of the concrete before pouring the main seal. Because of the many variations definite comparisons of the products are difficult, frequently impossible. Some typical examples chosen from observations on 62 jobs will, however, be given of the successes and failures experienced with this type of joint filler.



LEFT, A 2-INCH POURED RUBBER COMPOSITION SEAL IN GOOD CONDITION; RIGHT, A POURED RUBBER COMPOSITION SEAL THAT HAS EXTRUDED.

BOND BETWEEN JOINT FILLER AND PAVEMENT OFTEN INADEQUATE

On one job in Connecticut completed in 1936, a rubber compound was used to seal both the expansion and dummy joints. In November 1939 the original seal was entirely gone from all the expansion joints. In the dummy joints the original seal was still in place but was badly cracked and disintegrated. On this job trouble with the joint seal began immediately after the joints were poured. The bond secured between the filler and the concrete was apparently insufficient to prevent the filler from working loose and being carried away by traffic.

On two other Connecticut jobs, one completed in 1937, the other in 1938, a rubber compound was used as both filler and seal. By November 1939 approximately 10 percent of the joints had been refilled with asphalt. The seals that were in place still retained their elasticity but had separated or pulled away from the concrete, allowing dirt and moisture to enter.

In Maine in June 1938, 10 expansion joints were sealed with a rubber compound consisting essentially of rubber latex, granulated cork, and a filling powder. In November 1939 all the seals were found to be in place but more than half no longer adhered to the concrete and did not appear to be watertight.

In Maryland in May, June, and July 1939 the same kind of poured rubber compound was used on three jobs to seal the top 1.5 inches above the regular bituminous fiber joint fillers. On the first job about 25 percent of the expansion joints had to be cleaned out and resealed before proper bond was secured between

the seal and the concrete. When inspected late in October it was found that a great many of the joints again required resealing. On the other two jobs the expansion joints were rated as "excellent" when first completed. When inspected late in October, however, the bond between the filler and the concrete had failed on many joints to the extent that moisture could gain easy access. There were also indications on both jobs that the material had begun to lose its elasticity. These failures all occurred within less than 6 months after construction.

On one Massachusetts job completed in 1938 three types of poured rubber filler and seal were used. Of these, 59 joints were formed from a rubber material which was poured cold, 30 from a rubber material poured hot, and 4 were filled with a compound made up essentially of rubber latex, ground mica, and other materials. When inspected on November 17, 1939, it was found that all of the 59 cold-poured joints had lost so much of the bond with the concrete that the seal was ineffective. The hot-poured joints were tight, with good bond, and resembled in appearance an ordinary asphalt joint with considerable extrusion flattened out over the adjacent concrete. In the four poured-rubber-compound joints the material still retained its elasticity but the bond was found to be ineffective to some extent in each joint.

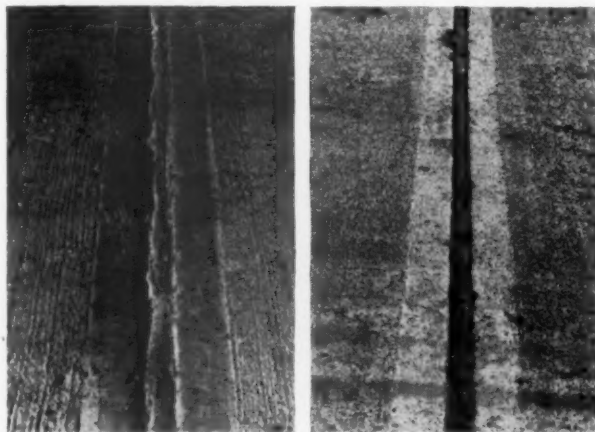
In another Massachusetts job completed in November 1936, all transverse joints were filled with a poured-rubber compound. The first installation failed to bond and the joints were refilled by the manufacturer in May 1937. Later that year the joints were thoroughly cleaned out by the producer of the material and completely new joints were poured. On November 20, 1939, nearly every joint was found to be cracked through the middle and had opened sufficiently to permit the free access of water and foreign materials. There was no appreciable extrusion. New joints were required.

In 1937 two poured-rubber compounds were used on a four-lane road in Massachusetts. The joints on one lane were filled with a material consisting essentially of rubber latex and a filling powder; the transverse joints of the other three lanes were filled with a material consisting of rubber latex, powdered filler, and granulated cork in the ratio of 16:4:1 by weight. The final seal was the same material without the cork. On November 22, 1939, it was found that joints of the first material had only a few cracks in the middle and that the material itself was still very elastic but the bond with the concrete was not very good. The rubber latex cork material, on the other hand, was found to have surface cracks in nearly every joint sufficient to permit the ready entrance of water and foreign materials. Adherence to the concrete was better than in joints where the first material was used. Traffic, however, had stripped the top seal to a depth of about half an inch in many places.

In 1938 the top 2 inches of the expansion joints on two Pennsylvania jobs were sealed with a rubber compound consisting essentially of rubber latex, filling powder, and granulated cork. The results were unsatisfactory even at an early date. On some of the joints the rubber compound was removed and the joints filled with bituminous material. In October 1939 the State maintenance forces sealed the remaining joints with asphalt.

In 1938 a different rubber-latex-filler compound was

used on several other jobs to seal the top 2 inches of the transverse expansion joints. In October 1939 the joints on all these jobs showed evidence of functional inadequacy. The joint material was pulling out, the edges were spalling, and the material itself showed signs of rapid deterioration.



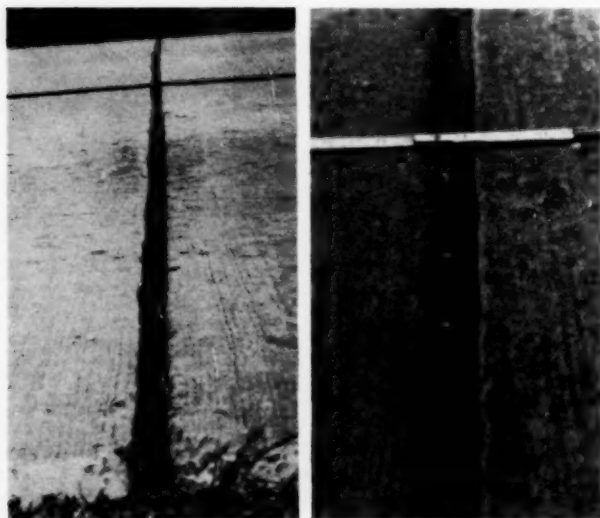
LEFT, APPEARANCE OF A Poured RUBBER COMPOSITION SEAL AFTER 16 MONTHS OF EXPOSURE TO WEATHER AND TRAFFIC; RIGHT, A BITUMINOUS-FILLED JOINT IN GOOD CONDITION AFTER 2½ YEARS.

PREFORMED RUBBER CAPS SHOWED TENDENCY TO ROTATE AND BUCKLE

Another form of rubber seal sometimes used is a formed or manufactured strip with a hollow core. This strip is compressed during installation so that when inserted and seated in the joint it will form a tight cap or seal. It then depends on its resistance to the deformation which it has undergone by being forced into the joint opening to provide sufficient pressure against the edges of the concrete slabs to maintain a watertight joint. The early trials indicated a strong tendency for the strip either to be forced down too deeply into the joint or to rotate partially and work to the surface where it was frequently torn out by passing traffic. In later trials the slab ends have been constructed with a square shoulder or seat about one-fourth inch wide formed in the concrete about 1¼ or 2 inches below the surface of the slab. The joint opening is thus one-half inch wider at the top than at the bottom. However, considerable difficulty has been experienced in forming this seat to the required exactness. Present indications are that the tendency of the strip to rotate has not been greatly decreased. Inspections on 16 different jobs showed that very few of these installations were entirely watertight. A tendency for the strip to work up and be pulled out by the action of passing traffic has also been noted.

Experiences reported from Indiana, Mississippi, and Ohio illustrate some of the advantages and disadvantages of this type of joint. On one project in Indiana joints of this type have been in service for 4 years. When inspected late in 1939 they were in satisfactory condition and showed no serious signs of deterioration. The air space in the joint below the rubber cap was often found to be full of water, but no large amount of silt had collected in the bottom. The ability of this type of rubber cap to keep the top of the joint space closed when the pavement contracts is very promising. There seems to be no advantage in supplementing this type of joint with crack filler. There is a tendency, however, for the rubber to be pushed upward so that

the wheels of traffic hit it and wear it out. This tendency is probably the result of compression caused by the closure of the joint in warm weather. It is believed that the compression causes the rubber to elongate and buckle sufficiently to push it above the surface of the pavement and expose it to wear.



LEFT, A PREMOLDED RUBBER CAP THAT HAS WORKED UP AND BEEN SUBJECTED TO HAMMERING BY TRAFFIC; RIGHT, A PREMOLDED RUBBER CAP THAT HAS ROTATED AND NO LONGER SEALS THE JOINT.

In Mississippi joints of this type were installed in November 1938 on about 1,000 feet of a 5.6-mile job.

When inspected on November 9, 1939, the joint material appeared to be in good condition, but tests with a knife blade indicated insufficient pressure of the rubber against the concrete slab to exclude water at all points. In one joint approximately 9 feet of the rubber sealing strip was gone. It appears that this rubber strip can be removed without the use of tools. Breaks were also noted in the strips where they are bent 90° at the edge of the pavement to carry the strip down the side of the slab.

The use of rubber or rubber compound as a seal or joint filler on Federal-aid work in Ohio has been practically limited to a preformed extruded rubber expansion joint filler or cap as a seal. The first installation of this material was in October 1936. The joints soon proved unsatisfactory, chiefly because of a tendency to become depressed too deeply into the joint opening, or to rotate within the joint opening and permit the entrance of water and foreign materials.

Later designs provide for the formation of a shoulder on each side within the joint opening on which the rubber seal rests. This is obtained by making the lower part of the joint opening 1 inch wide and the upper part in which the rubber is inserted, 1.25 inches wide. The shoulder on each side would then be one-eighth-inch wide at the top. Considerable difficulty has, however, been encountered in forming a true and neat shoulder. An inspection late in 1939 of the the seven Federal-aid jobs on which this type of extruded rubber expansion joint was used, showed the conditions summarized in table 1.

A number of State highway departments have done considerable work toward developing satisfactory materials for sealing the tops of expansion joints. These

materials are for the most part composed of a mixture of rubber latex with asphalt or tar, to which other substances such as ground cork, flake mica, or other ground or powdered substances are frequently added.

TABLE 1.—Condition of extruded rubber expansion joints used on 7 jobs in Ohio

	Job number—						
	1	2	3	4	5	6	7
Date completed	7-20-39	7-20-39	8-12-39	9-11-39	(1)	(1)	(1)
Joints with filler too high	Percent 4	Percent 5	Percent 3	Percent 2	Percent 2	Percent 1	Percent 2
Joints with filler too low	12	14	10	8	1	1	1
Joints with filler extruded above pavement surface	2	3	1	1	0	0	0
Joints with filler cracked	1	2	1	1	0	0	0
Joints with incipient spalling of concrete	6	7	5	3	2	1	2
Joints with progressive spalling of concrete	2	3	2	1	0	0	0
Joints with filler rotated	2	2	0	0	0	0	0
Maintenance to date	None	None	None	None			

(1) Under contract; construction not yet completed when inspected.

SEALS CONTAINING BITUMINOUS MATERIALS USED WITH VARYING SUCCESS

California has used a material consisting essentially of about 70 percent SC-4 cutback and 30 percent rubber latex as both a seal and a filler. This material was apparently first used on a Federal-aid job in 1935 on about 680 linear feet of expansion joints on the heavily traveled highway between Lebec and Grapevine in Kern County. These joints, spaced at 100-foot intervals, were sealed immediately after the concrete surface was completed. Due to the dampness of the concrete, short sections of the seal were soon pulled out by traffic and had to be replaced. There have been no further failures, and no maintenance has been required to date. When inspected in October 1939 the rubber compound joints were intact and in good condition.

Later experience with this material indicates that, while superior in producing an effective seal, it must be relatively soft in order to be effective. However, when this material is soft it is also very adhesive so that foreign materials readily adhere and are kneaded into the joint under the action of traffic. In many instances sufficient extraneous materials have in this way been accumulated and worked into the joint filler to reduce seriously its ability to provide for expansion. The soft consistency of the material also permits it to flow out of the joint on sections having high super-elevation. The cost is approximately double that of the standard joint fillers.

Oregon has used as a seal, with what are said to be promising results, a mixture of 30 percent rubber latex (60 percent solution) and 70 percent of 150-200 penetration asphalt. This mixture is poured hot and the seal allowed to come to within about one-fourth inch of the level of the pavement surface. The hot material is then covered with sufficient rubber grindings, of the kind and size ordinarily obtained from tire retread establishments, to complete the final seal and filling of the joint.

Massachusetts and Oklahoma have also been using to some extent somewhat similar compounds as a seal or filler. The formula used by Oklahoma is given in table 2.

TABLE 2.—Formula for joint filler used by Oklahoma

Material	Amount by—	
	Weight	Volume
SC-4 oil	Lb. 5.475	0.690 gal.
38 percent latex	2.431	0.299 gal.
Lime	.0553	0.709 oz.
Cresol soap solution	.0444	14.3 cc.

That at least some of these rubber materials and compounds have considerable merit is indicated by the

(Continued from page 56)

Local motor-vehicle imposts in Missouri are most extensively used by the larger cities. In the smaller places the greater part of the street work is accomplished by means of State highway expenditures within their corporate limits.

The relatively small increases in collections from local motor-vehicle license fees at a time of rapidly increasing motor-vehicle registrations in the State suggest possible difficulty in the collection of the local taxes and make it apparent that some more satisfactory method of obtaining an equal or larger amount of revenue is desirable.

Complete data are not available on the cost of collecting the local taxes, but there is evidence that these costs are high, and when compared with State costs for similar operations, absorb a large percentage of the total collections.

Difficulties have been encountered in the collection of the local motor-fuel taxes. Particularly in the smaller places, evasion by means of the location of gasoline stations outside city limits is frequent. This difficulty is lessened in the larger cities where the size of the cities and the number of vehicles require many refueling stations inside city limits.

The experiences of many States indicate the difficulty of completely stopping bootlegging of gasoline and other evasions of the motor-fuel tax. Within Missouri, where municipal motor-fuel taxes range from 1 cent per gallon downward, the incentive for tax evasion across city limits may not be as great as it is across State lines, where the differential in State taxes may be from 1 to 5 cents per gallon. However, the incentive does exist and it can hardly be doubted that the cities that levy local motor-fuel taxes would collect larger amounts but for evasion.

Both the local motor-vehicle license fees and the local motor-fuel taxes are duplications of State-levied taxes from which much larger amounts are obtained for the State's use. In addition to duplication of tax there is also duplication of tax collection and administration operations within the State.

Local motor-fuel taxes and motor-vehicle license fees are not used extensively in other States to finance local streets. Funds for that purpose are derived in those places from other forms of local taxation or from financial assistance provided by the county or State. The use of this form of local financing has not tended to increase in recent years, either in Missouri or in other States. Statutory restrictions and practical administrative objections have led the local units elsewhere generally to seek other methods of financing street construction and maintenance.

number of instances in which their use has given satisfactory results. On the other hand a much larger number of reports of unsatisfactory results indicate that as a class these rubber compounds are still in the experimental stage. In some cases the materials or combinations of materials appear to be at fault. In other cases there is considerable evidence that the materials are capable of giving satisfactory results but more definite knowledge must be obtained as to how and under what conditions they can be successfully used. Weather conditions during installation, especially temperature and moisture, appear to affect the performance of most, if not all, of the poured types.

APPENDIX

Provision for limiting local license fees was initially made in the Missouri Revised Statutes of 1919. The law, limiting local fees to one-half of the State license fees, was continued by a 1921 law.

As the result of an initiative petition passed by the electorate of Missouri in 1924 the State license rates were increased 50 percent in 1925.¹

The provision of the 1921 act which permitted the municipalities to levy a local license fee at one-half the State rate was replaced by the new provision limiting the local rates to one-third of the increased State rates.

The Revised Statutes of 1929 contained two conflicting provisions.² Sections 7761 and 7762, which were carried forward from section 5 of the 1921 act and section 15 of the 1925 act, limited "license taxes levied on motor vehicles of the State by municipal corporations" to not more than "one-third of the aggregate amount of the State registration fee * * * including the cost of plates and notarial fee." However, in section 7780 of the same statutes, which was brought forward from the 1921 sessions acts, the change from one-half to one-third was not made. Consequently there was found in this section the statement that municipalities could require (except in cities having a population of more than 75,000) the display of license plates "but such license taxes shall not exceed one-half of the registration fee provided for herein, including the cost of plate and notarial fee."

Thus, there were two different provisions in the statutes. One provision restricted the local fees to one-third of the State fees and the other permitted the towns and cities to charge license fees up to one-half of the State fees. The latter provision, contained in section 7780, should have been revised by reason of enactment of sections 7761 and 7762, but was allowed to remain in the statutes through error. An opinion by the Legal Department of the State Highway Department regarding section 7780 contained two rather lengthy supreme court decisions and stated in part: "The fact that the committee brought the said act forward and placed it in the revised statutes gave it no validity." The statement is made that the actual revision had occurred through enactment of other sections and, "The sections of the act were simply brought forward and placed in the article by the committee on revisions which was appointed to compile, arrange, and publish statutes after the adjournment of the general assembly. That committee had no legal power conferred upon it, for the legislature could not, and, indeed, did not attempt to delegate to it, any such powers."

¹ Session Acts of 1925, sec. 15, p. 288.

² Ch. 41, art. 1.

The rate of one-half of the State license fees contained in section 7780 was, therefore, not permissible because of revisions of sections 7761 and 7762. As a result of the changes in the law and the conflicting provisions, considerable confusion existed as to the legal basis for establishing municipal license fees. Some cities succeeded in operating under section 7780 which permitted local rates at one-half the State rates, even though this section legally was noneffective.

At the extra session of the Missouri Legislature in 1933-34 the State license fees (established by the 1925 act) were lowered. Sections 7761, 7762, and 7769 were repealed and new sections enacted bearing the same numbers. The last paragraph in the revised section 7761 stated: "Fees charged by municipalities for said license shall not exceed the amount authorized therefor by said municipalities during the year 1933." This provision allowed those rates which had been based on the higher (1925) State rates and established by the cities prior to 1933 to remain unreduced but prohibited the municipalities from increasing the local rates in effect at that time. Since the State rates had been lowered it was therefore possible for a city rate to exceed one-third the new 1934 State rate without being in conflict with the statutes.

However, through an oversight section 7780 was not revised during the 1933-34 session. The two conflicting provisions regarding the basing of local fees on one-third and one-half of the State fees continued to cause confusion until section 7780 was finally repealed and the law clarified by the 1935 session of the legislature. A new section bearing the same number was enacted in 1935 with various changes, one of which was, "Such (municipal) license fees shall not exceed the limitations on registration fees, now or hereafter provided by law."

Consequently, the schedule of license fees shown in the second column of table 2 (p. 50) was legally in effect up to 1933 and remained in effect after 1933 for those cities which had established a local motor-vehicle license fee prior to 1933. For all local fees established after 1933 the rates were based on one-third of the State rates as provided in sections 7761, 7762, and 7780 (as revised in 1935).

The statutory development of the bases for establishing municipal motor-vehicle license fee rates in Missouri from 1921 to 1935 is shown in table I.

TABLE I.—Statutory development of municipal motor-vehicle license fee rates in Missouri, 1921-35

Date of law	State license fee	Municipal license fees for passenger cars—	
		Based on—	Amount
1921 (continued from 1919 act)	\$5.00	One-half of State rate	\$2.50
	7.00		3.50
	11.00		5.50
	15.00		7.50
	17.00		8.50
	21.00		10.50
1925 (revised the State license rates established by 1921 act).	25.00	One-third of State rate	12.50
	7.50		2.50
	10.50		3.50
	16.50		5.50
	22.50		7.50
	25.50		8.50
1929 Revised Statutes; secs. 7761, 7762 (carried forward from sec. 5 of 1921 act and sec. 15 of 1925 act).	31.50	One-third of State rate	10.50
	37.50		12.50
	7.50		2.50
	10.50		3.50
	16.50		5.50
	22.50		7.50
1929 Revised Statutes; sec. 7780 (carried forward from sec. 24, par. C, of 1921 act).	25.50	One-half of State rate	12.75
	31.50		15.75
	37.50		18.75
	7.50		3.75
	10.50		5.25
	16.50		8.25
1933-34 (Revised the State license rates established by 1925 act, but did not eliminate conflicting provisions of 1929 Revised Statutes).	22.50	One-third of State rate for new local fees. Previously established rates not affected.	11.25
	31.50		15.75
	37.50		18.75
	5.00		1.66
	8.50		2.83
	11.00		3.66
1935	20.00	One-half of State rate for new local fees. Previously established rates not affected. (This provision allowed to remain in statutes through error. Rate not permissible because of secs. 7761 and 7762.)	6.66
	25.00		8.33
	31.50		10.50
	37.50		12.50
	5.00	One-third of State rate for new local fees (sec. 7780 finally revised).	1.66
	8.50		2.83
	11.00		3.66
	20.00		6.66
	25.00		8.33
	31.50		10.50
	37.50		12.50

HIGHWAY RESEARCH BOARD PROCEEDINGS NOW AVAILABLE

The Highway Research Board of the National Research Council has announced that Volume 19, Proceedings of the Highway Research Board, is now available. Copies may be obtained from the Highway Research Board, 2101 Constitution Avenue, Washington, D. C., at \$2.25 each.

The volume includes papers and committee reports on the subjects of Highway Finance, Economics, Design, Roadside Development, Materials, Maintenance, Traffic and Safety, Soil Mechanics, and a symposium on Soil Stabilization Practices.

STATUS OF FEDERAL-AID HIGHWAY PROJECTS

AS OF APRIL 30, 1940

STATE	COMPLETED DURING CURRENT FISCAL YEAR			UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			BALANCE OF FUNDS AVAILABLE FOR UNCOMPLETED PROJECTS
	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	Estimated Total Cost	Federal Aid	Miles	
Alabama	\$ 6,810,105	\$ 3,298,328	283.7	\$ 4,920,367	\$ 2,436,713	139.6	\$ 1,749,990	\$ 871,390	76.8	\$ 3,509,747
Arizona	2,261,514	1,584,429	120.1	1,673,121	1,126,377	76.6	144,886	81,613	6.9	1,783,755
Arkansas	5,031,960	3,991,059	226.4	2,069,957	1,106,578	93.4	992,585	490,595	50.2	1,598,915
California	5,695,326	3,052,622	90.2	6,992,876	3,674,673	117.5	2,134,867	1,083,800	50.9	4,225,532
Colorado	3,917,643	2,130,112	89.3	1,608,496	904,689	44.6	620,375	349,643	14.3	3,297,231
Connecticut	871,663	431,585	10.0	1,529,281	761,293	16.4	1,292,822	622,750	9.2	1,361,864
Delaware	844,413	403,702	31.3	1,133,702	565,383	7.2	865,244	315,213	17.2	1,276,312
Florida	3,166,669	1,560,487	33.2	4,152,831	2,070,296	123.2	649,498	364,749	7.2	2,536,320
Georgia	4,687,725	2,204,928	238.4	5,230,205	2,615,103	286.9	2,634,711	1,317,356	78.6	7,075,403
Idaho	2,205,025	1,294,157	113.9	1,023,052	624,163	78.2	394,664	238,433	23.0	2,171,193
Illinois	6,742,598	4,320,905	195.7	7,749,772	3,872,897	136.1	2,366,100	1,171,050	85.1	5,006,733
Indiana	4,588,844	2,208,246	88.7	5,307,303	2,647,245	111.8	2,571,130	1,285,480	48.7	2,947,131
Iowa	3,999,731	1,875,169	198.2	4,583,925	2,101,692	151.8	1,883,217	887,300	56.9	2,214,537
Kansas	3,859,948	1,881,676	193.9	3,280,462	1,635,944	171.9	4,727,210	2,348,658	327.7	5,006,448
Kentucky	3,531,257	1,845,809	112.3	1,755,583	876,225	31.0	2,955,584	1,477,842	58.4	3,805,588
Louisiana	1,191,830	592,686	36.7	1,703,964	2,895,343	33.9	1,672,636	828,697	50.7	3,715,371
Maine	2,136,387	1,056,517	52.4	747,557	373,778	16.7	40,660	20,340	1.6	1,308,265
Maryland	2,909,976	1,403,023	39.5	1,755,275	869,320	33.2	1,931,200	661,000	15.7	1,924,651
Massachusetts	3,134,614	1,564,618	25.1	1,791,897	892,575	15.3	777,517	387,858	6.9	3,762,699
Michigan	4,868,223	2,321,815	115.4	3,952,679	1,888,339	128.2	4,877,973	2,438,987	139.7	3,187,352
Minnesota	5,732,519	2,843,636	389.5	3,542,911	1,753,995	171.0	2,173,807	1,085,889	202.0	5,518,691
Mississippi	5,985,268	2,860,999	261.4	5,518,748	2,018,135	197.5	2,564,393	1,106,952	187.2	2,543,936
Missouri	3,962,465	1,955,764	150.8	4,238,050	2,013,934	127.8	4,337,776	1,625,702	176.4	6,179,855
Montana	3,350,311	1,893,059	196.9	2,685,271	1,521,633	151.9	1,641,954	928,918	147.9	4,674,155
Nebraska	4,893,585	2,386,774	418.0	4,400,060	2,086,615	471.2	2,598,518	1,500,168	408.8	3,406,537
Nevada	1,195,292	1,003,504	57.8	1,365,005	1,191,198	69.6	7,516	6,252	1.1	1,794,469
New Hampshire	814,656	400,842	27.3	922,218	453,607	19.8	1,107,787	437,494	22.1	957,230
New Jersey	856,420	418,696	7.1	6,254,528	3,126,314	50.2	200,130	100,065	.1	2,205,194
New Mexico	2,342,048	1,421,597	172.0	1,501,352	6,159,561	73.1	311,921	188,706	51.8	2,141,056
New York	8,664,045	4,169,300	167.2	12,573,737	6,159,601	178.5	2,096,540	901,420	43.8	5,100,087
North Carolina	5,747,742	2,863,592	353.3	4,638,485	2,319,032	220.5	1,601,010	800,375	80.6	2,796,078
North Dakota	296,609	157,147	41.7	1,602,970	869,760	104.4	2,885,553	1,615,637	282.8	4,458,283
Ohio	6,153,802	3,016,114	86.2	9,315,092	4,634,172	78.3	6,877,551	3,438,590	72.1	6,025,974
Oklahoma	3,155,606	1,669,753	142.8	3,128,335	1,658,980	73.8	2,220,945	1,142,271	112.4	4,680,927
Oregon	2,987,948	1,788,339	113.1	3,276,833	1,848,802	134.6	671,889	397,990	30.0	1,994,053
Pennsylvania	5,161,420	4,728,818	113.7	6,742,796	3,222,572	63.8	5,868,505	2,727,007	65.2	5,361,650
Rhode Island	672,284	325,167	7.8	1,181,937	590,000	11.6	469,511	234,224	5.0	1,055,522
South Carolina	2,715,688	1,217,808	85.1	1,727,917	818,444	105.8	948,109	457,368	84.3	2,807,189
South Dakota	3,396,697	1,892,686	330.0	3,031,640	1,726,790	346.2	1,918,680	1,090,700	291.2	3,948,312
Tennessee	4,831,038	2,337,467	104.3	3,035,002	1,517,501	62.3	1,077,856	538,928	48.8	4,744,924
Texas	14,084,456	6,923,626	731.4	10,331,172	5,105,387	520.3	1,691,659	835,774	107.8	8,581,377
Utah	2,323,405	1,611,553	98.1	868,395	665,015	51.4	375,910	256,417	40.0	1,579,355
Vermont	738,233	348,926	18.4	927,657	463,616	28.9	508,070	250,028	12.0	567,464
Virginia	2,512,645	1,243,967	82.2	2,945,515	1,407,768	67.4	381,380	184,671	11.1	2,631,303
Washington	2,257,684	1,141,462	38.5	3,839,760	2,022,086	52.1	498,335	263,200	13.4	1,696,585
West Virginia	1,963,394	1,035,382	50.1	1,736,756	865,022	51.2	900,670	446,240	16.5	2,869,785
Wisconsin	5,159,018	2,599,616	187.5	5,021,815	2,464,880	153.2	498,382	245,155	16.2	4,241,006
Wyoming	1,562,428	955,758	141.3	1,866,236	1,176,853	195.9	73,408	35,855	10.9	1,463,489
District of Columbia	326,244	161,490	2.5	468,460	233,212	3.8	393,500	196,800	3.4	456,623
Hawaii	499,394	232,151	2.1	407,876	403,916	14.5	433,940	215,300	7.7	1,602,895
Puerto Rico	707,642	351,850	14.1	1,306,457	646,785	25.3	40,640	20,065	1.2	916,720
TOTALS	183,854,400	93,907,776	6,890.4	183,795,341	90,229,730	5,689.7	82,601,611	40,473,215	3,666.5	160,717,591

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Report of the Chief of the Bureau of Public Roads, 1935. 5 cents.
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Single copies of the following publications may be obtained from the Public Roads Administration upon request. They cannot be purchased from the Superintendent of Documents.

MISCELLANEOUS PUBLICATIONS

- No. 296MP . . Bibliography on Highway Safety.
House Document No. 272 . . . Toll Roads and Free Roads.
Indexes to PUBLIC ROADS, volumes 6-8 and 10-19, inclusive.

SEPARATE REPRINT FROM THE YEARBOOK

- No. 1036Y . . Road Work on Farm Outlets Needs Skill and Right Equipment.

TRANSPORTATION SURVEY REPORTS

- Report of a Survey of Transportation on the State Highway System of Ohio (1927).
Report of a Survey of Transportation on the State Highways of Vermont (1927).
Report of a Survey of Transportation on the State Highways of New Hampshire (1927).
Report of a Plan of Highway Improvement in the Regional Area of Cleveland, Ohio (1928).
Report of a Survey of Transportation on the State Highways of Pennsylvania (1928).
Report of a Survey of Traffic on the Federal-Aid Highway Systems of Eleven Western States (1930).

UNIFORM VEHICLE CODE

- Act I.—Uniform Motor Vehicle Administration, Registration, Certificate of Title, and Antitheft Act.
Act II.—Uniform Motor Vehicle Operators' and Chauffeurs' License Act.
Act III.—Uniform Motor Vehicle Civil Liability Act.
Act IV.—Uniform Motor Vehicle Safety Responsibility Act.
Act V.—Uniform Act Regulating Traffic on Highways.
Model Traffic Ordinances.

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AS OF APRIL 30, 1940

TOTALS